

## ARCO CHLORIDE TECHNOLOGY

The general program objective is to produce anhydrous aluminum chloride from clay. The anhydrous aluminum chloride serves as a feed to the Alcoa bipolar electrolysis cell. The overall process is to produce primary metal from domestic clay at a substantial savings over the best available Bayer-Hall technology. The 1983 program work is divided into two major areas (1) Ore to PCACH and (2) Reactor Technology.

### Ore to PCACH

A capital, operating, and mining cost estimate for an 800 k tpy plant producing PCACH from clay completed. This serves as a basis for techno-economic analysis of the process. An assessment of the current state of information relative to the design of a demonstration plant was carried out. Based on this the areas of ACH decomposition and gas sparging crystallization of ACH were identified as requiring work at the laboratory scale. The bleed stream treatment section of the clay plant was the least well characterized. A pilot scale bleedstream system was constructed and operated at a feed rate of  $\sim 40$  lb/hr. Start up and debugging commenced in September 1983, and operations were completed on January 27, 1984. The HCl Stripper system and one and two stage evaporative crystallization were tested. Operation proved that the design would accomplish the necessary HCl(g) and ACH recovery. Detailed analysis of the results and incorporation of the operating details into the clay plant simulation are in progress.

A lab scale ( $\sim 1$  lb/hr) indirectly heated fluid bed calciner was built to carry out experimental work on ACH decomposition technology and a gas sparging crystallizer (15-20 lb/hr ACH) was built and operated to develop a model for the crystallization process. These units will now provide a basis for setting material specifications and design criteria for the demonstration plant.

### Reactor Technology

ARCO Metals has experimentally shown, which was also confirmed by Alcoa, that PCACH can be chlorinated at relatively low temperatures ( $\approx 650^{\circ}\text{C}$ ) with a high mass transfer coefficient ( $> 14 \text{ k mole Cl}_2/\text{m}^2\cdot\text{hr}\cdot\text{atm}$ ), low carbon consumption ( $< 0.46 \text{ lb coke/lb Al}$ ) and with no make-up chlorine. The CxCly levels in the  $\text{AlCl}_3$  from steady state reactors was  $\approx 1000 \text{ ppm}$  using ARCO treated coke. The major 1983 effort was to eliminate CxCly through reaction technology and coke treatment.

It was found that steam calcined disordered green coke reduced the CxCly to  $\approx 600 \text{ ppm}$  which meets the  $\text{AlCl}_3$  specifications of  $\leq 1000 \text{ ppm}$ . Destruction reactions of CxCly post to the reactor has shown experimentally it is possible to reduce the CxCly to  $\leq 1 \text{ ppm}$ . These studies are being further examined in 1984.

A continuous green coke steam calciner was designed and constructed to produce  $\sim 1 \text{ lb/hr}$  calcined coke. A two-inch continuous feed pressure fluid bed reactor was designed, constructed, and operated for periods  $> 8 \text{ hours}$  which produced  $\sim 1 \text{ lbs AlCl}_3/\text{hr}$ . This reactor will confirm the commercial mathematical model for design of the Anderson County reactor in the joint ARCO-Alcoa program.